

What is claimed is:

- Sub B1
- 1 1. A method of forming a Cu alloy, comprising:
 - 2 plating a layer of Cu over a substrate;
 - 3 forming a dopant layer over the Cu layer;
 - 4 driving dopants from the dopant layer into the Cu layer; and
 - 5 removing the dopant layer.

- 1 2. The method of Claim 1, wherein the substrate comprises a diffusion
- 2 barrier layer overlying a dielectric layer.

- 1 3. The method of Claim 2, wherein the diffusion barrier layer comprises a
- 2 material selected from the group consisting of Ta, TaN, TaSiN, W, WN, WSiN,
- 3 Ti, TiN, TiSiN, and Co.

- 1 4. The method of Claim 2, wherein forming the dopant layer comprises
- 2 plating a layer of metal.

- 1 5. The method of Claim 4, wherein the metal layer comprises at least one
- 2 element which when alloyed with Cu improves an electromigration characteristic
- 3 of Cu.

1 9. The method of Claim 6, wherein driving dopants into the Cu layer
2 comprises elevating the temperature of the dopant layer and Cu layers to
3 between 300°C and 400°C.

1 10. A method of forming a Cu alloy, comprising:
2
3 plating a layer of Cu over a substrate; and
4
5 implanting at least one dopant element into the Cu layer.

1 12. The method of Claim 10, further comprising polishing the layer of Cu so
2 as to form individual interconnect lines prior to implanting.

19. A method of forming a Cu alloy, comprising:
depositing a seed layer on a substrate, the seed layer comprising Cu and
at least one doping element;

- 4 forming a capping over the seed layer;
5 forming a layer of Cu over the capping layer; and
6 driving the at least one doping element from the seed layer into the Cu
7 layer.

1 20. The method of Claim 19, wherein the seed layer and the capping layer are
2 formed sequentially and without exposing the seed layer to the atmosphere prior
3 to deposition of the capping layer.

1 21. The method of Claim 20, wherein the seed layer and the capping layer are
2 deposited in the same PVD system without breaking vacuum.

1 22. The method of Claim 19, wherein depositing the seed layer comprises
2 sputtering a metal alloy, the metal alloy having at least one element that diffuses
3 in Cu at a temperature less than or equal to 400°C.

1 23. The method of Claim 22, wherein the metal alloy is selected from the
2 group consisting of CuSn and CuMg.

1 24. The method of Claim 22, wherein forming the capping layer comprises
2 sputtering Cu.

1 25. The method of Claim 19, wherein driving the at least one doping element
2 from the seed layer into the Cu layer comprises heating the substrate to
3 temperature in the range of 300°C to 400°C.

1 26. The method of Claim 25, further comprising exposing at least the surface
2 of the Cu layer to an ambient that reacts with the doping element.

1 27. The method of Claim 26, wherein the ambient comprises nitrogen.

1 28. The method of Claim 26, wherein the ambient comprises oxygen.

1 29. The method of Claim 19, wherein the substrate comprises a patterned
2 dielectric layer having a copper diffusion barrier disposed of the surfaces thereof;
3 depositing the seed layer comprises a physical vapor deposition in the absence
4 of oxygen; forming the capping layer comprises a physical vapor deposition of
5 Cu; forming the Cu layer comprises electroplating; and driving the at least one
6 doping element from the seed layer into the Cu layer comprises heating the
7 substrate and, concurrently therewith, exposing the Cu layer to at least one
8 chemical that will react with the at least one doping element such that the at
9 least one doping element is drawn to the surface of the Cu layer.